Does Shoulder Joint ROM Predict Medial Elbow Joint Space and UCL Thickness?

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Abstract

Baseball athletes, especially pitchers, are prone to ulnar collateral ligament (UCL) injuries of the elbow. It is well documented that baseball athletes typically exhibit an increase in shoulder external rotation range of motion (ERRM) and a decrease in internal rotation range of motion (IRRM) while maintaining total rotational range of motion (TROM) in his throwing extremity. Furthermore, loss of TROM and ERRM may be associated with increased risk for UCL injury. Ultrasound imaging allows clinicians to evaluate UCL thickness and medial joint space (MJS) opening non-invasively. ***PURPOSE:*** To examine if shoulder joint motion (ERRM, IRRM, TROM), predicts medial elbow joint space (MJS) opening and UCL thickness in asymptomatic collegiate baseball pitchers at the start of pre-season workouts. ***METHODS:*** Nineteen asymptomatic NCAA Division I collegiate baseball pitchers (age 20.4 ± 1.45 yrs) participated in this study. Ultrasound images were obtained of the medial joint space and UCL on the participant's throwing arm using a GE LOGIQ e ultrasound unit. Participants were placed supine with a wedge placed underneath their pitching hand to maintain elbow position at 30 degrees. A 3 kg valgus force, as measured by a hand held dynamometer, was applied 20 cm distal to the medial epicondyle. Ligament thickness measurements were performed at the mid-substance of UCL and at the apex of the trochlea. Imaging measurements to evaluate MJS opening were performed from the apex of the trochlea to the apex of the ulna. Standard goniometric procedures were performed with the athlete in a supine position to obtain ERRM, IRRM, and TROM values. Three stepwise linear multiple regression analyses were performed to determine if shoulder joint motion could predict UCL thickness and MJS. ***RESULTS:*** Shoulder joint range of motion was not able to significantly predict MJS [R2 = .05, F (2,16) = 0.44, p=0.65,], UCL thickness at the mid-substance [R2 = .01, F (2,16) = 0.12, p=0.89], or UCL thickness at the apex of the trochlea [R2 = .04, F (2, 16) = 0.36, p=0.70]. ***CONCLUSIONS***: Measures of shoulder joint ROM do not predict medial elbow joint space or UCL thickness in asymptomatic baseball pitchers at the start of the season. Further research is recommended to perform multiple imagining sessions throughout the competitive season to further evaluate relationships between shoulder ROM and medial elbow structures.

Introduction

The use of ultrasound imaging has been in medical practice since the 1950s and recently since the 1980s.[1] The use of ultrasound imaging has been used more regularly to assist the accuracy of the clinical examination in the musculoskeletal orthopedic setting.[2] The enhanced use has been attributed to the safe, portable and less expensive alterative to the MRI. [3] Furthermore ultrasound imagery is an excellent compliment or alterative to other forms of radiography imaging since all patients can undergo sonography the use of sonography is more patient friendly especially those patents that experience claustrophobia and is non-invasive free of radiation.[3,4] The use of sonography to evaluate medial elbow pain has been increasing in popularity. To date the use of sonography has been investigated in several ways to enhance the clinical accuracy of the elbow exam. Ciccotti et al [2] indicated that the use of stress US can detect changes to the UCL in asymptomatic professional baseball pitchers. More recently Roedle et al [5] concluded that that conventional US is as accurate as MR arthrography in diagnosing UCL tears. The purpose of this study was to examine if shoulder external rotation range of motion (ERRM), internal rotation range of motion (IRRM) and total rotational range of motion (TROM) predicts medial elbow joint space (MJS) opening and UCL thickness in asymptomatic collegiate baseball pitchers at the start of pre-season workouts.

Methods

Subjects: Nineteen NCAA Division I college men's baseball pitchers participated with a mean age of 20.4±1.45 SD and body mass index 24.56±1.78 SD. Subjects gave written informed consent before participating, and the protocol was approved by Florida Gulf Coast University's Institutional Review Board.

Design: A non-randomized hierarchical step-wise linear regression model was utilized for prediction due to the hierarchical nature of the data set.

The single independent variable was total shoulder ROM time measured prior to the beginning of the academic year. The dependent variables measured in this study through three regression models were medial joint space (cm) and UCL thickness at two distinct points.

Methods Cont.

Procedures:

- Ultrasound images were obtained of the anterior band of the UCL and the medial articulation of the humerus and ulna on the participant's throwing arm using a GE LOGIQ E ultrasound unit (GE Healthcare, Chicago, IL, USA) with a linear probe at 12 MHz.
- Participants were placed in a supine position with a wedge placed underneath their forearm to maintain their elbow position at a 30˚ flexion angle. A 3 Kg valgus stress was applied 20 cm distal to the medial epicondyle (see Fig. 1).
- Measurements from the apex of the trochlea to the apex of the ulna were taken and UCL thickness was measured at the mid-substance and at the apex of the trochela (see Fig. 2) at the beginning of the competitive baseball season.
- ERRM and IRRM measurements were obtained utilizing a JAMAR EZ Read goniometer (Patterson Company, Warrenville, IL , USA)
- Standard goniometric procedures were performed with the athlete in a supine position to obtain ERRM, IRRM, and TROM values.

Figure 1. Musculoskeletal ultrasound evaluation of the medial elbow joint complex during a valgus load

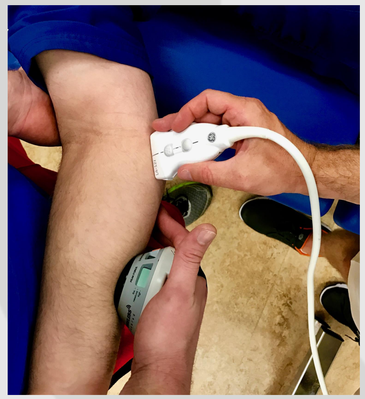
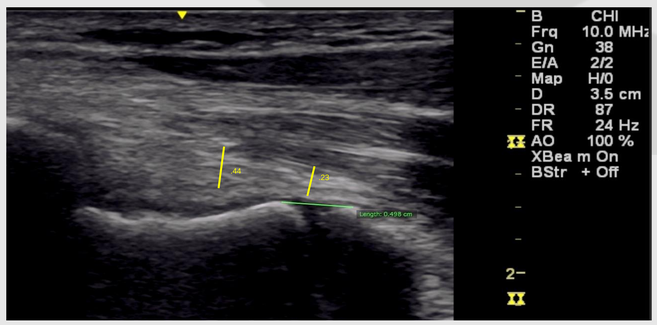


Figure 2. Ultrasound image of medial joint space width measurement and UCL Thickness during valgus load



Statistical Analyses

- The descriptive statistics (means, standard deviations were calculated for MJS width and the control variables.
- Three stepwise linear multiple regression analyses were performed to determine if shoulder joint motion could predict UCL thickness at two locations (mid-substance and apex of trochlea) and MJS
- The level of significance was accepted at the P ≤ 0.05 value.

Results

- The descriptive statistics for age, BMI, along with years of experience, TROM, ERRM, and IRRM, MJS, and UCL thickness at mid-substance and apex of trochela are provided in Table 1.
- Pearson Bivariate Correlations presented in Table.2
- Hierarchical linear regression analysis was used to test if shoulder joint range of motion predicted UCL thickness and MJS. The results of the three stepwise linear regression indicated that shoulder range of motion was not able to predict MJS (R^2 = .05, F(2, 16) = 0.44, *P* = .065, UCL thickness at the mid-substance(R^2 = .01, F(2, 16) = 0.12, *P* = .89, or UCL thickness at the apex of the trochela (R^2 = .04, F(2, 16) = 0.36, *P* = .70 Table 3 & 4

Table 1: Descriptive Statistics, Means, SD

	Mean	Std. Deviation
Age	20.4	1.78
Body Mass Index	24.56	1.78
Year of Intercollegiate Experience	2.15	1.068
TROM	177.63	17.39
ERRM	122.58	11.87
IRRM	55.05	10.65
MJS	0.52	0.08
Mid-substance	0.39	0.05
Apex of Trochela	0.20	0.03

Table 3: ANOVA for Predictors of MJS

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.006	2	.003	.44	.659
	Residual	.102	16	.006		
	Total	.108	18			

a. Dependent Variable: MJS

b. Predictors: (Constant), Total ROM, IRRM

Table 4: ANOVA for Predictors of UCL Thickness

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.001	2	.00	.12	.89
	Residual	.037	16	.002		
	Total	.037	18			
2	Regression	.001	2	.000	.361	.702
	Residual	.018	16	.001		
	Total	.019	18			

a. Dependent Variable: UCL Thickness MJS, Apex of Trochela

b. Predictors: (Constant), Total ROM, IRRM

Results cont.

Table. 2 Pearson Correlations Between Shoulder ROM and MJS and UCL Thickness

	UCL Mid-Sub	*UCL Apex*	*MJS*	*IRRM*	*ERRM*	*TROM*
UCL Mid-Sub	1					
UCL Apex	.696**	1				
MJS	.198	.096	1			
IRRM	.116	.166	.194	1		
ERRM	-.011	-.092	-.082	.190	1	
TROM	.063	.039	.063	.742**	.799**	1
				** sig at	0.01	
				* sig at	0.05	

Discussion

A primary goal of sports medicine practitioners are to determine causative factors for injury and develop a preventative program to assist in the reduction of injuries. Thus, the purpose of this study was to evaluate the effects of healthy pitchers' shoulder range of motion time on the medial elbow joint space and UCL thickness. Prior investigations of the MJS comparing dominant and non-dominant extremity revealed a joint space gap of .456cm ±.11, and .372 ± ,92, respectively. Furthermore, this study indicated that over a two year period the joint space in the dominant extremity examined during the spring training pre-participation examinations increased on average .037 cm. In prior investigations we have found the MJS space to increase.07cm during a 6 week in-season period. From these findings, we wanted to examine the effects of causative factors to explain the changes we found during a 6 week in-season period..

The results of this investigation demonstrated that MJS width and UCL integrity can be assessed accurately using diagnostic ultrasound during a valgus stress test. Moreover, these data indicate that shoulder range of motion at the beginning of the season did not have an influence on the MJS width or UCL thickness.

Limitations of this study include the sample size of our study, the limited number of measurements, the limited amount of time between the measurements, and the lack of control for the number of pitches thrown by the participants.

Conclusion

Further research is recommended to perform multiple imaging testing throughout the entire year (Fall and Spring seasons) to determine specific time points at which MJS width changes in collegiate baseball pitchers. Furthermore, future research should focus on the the effects of varying ROM throughout the entire year (Fall and Spring seasons) at the shoulder and lower extremity to further determine other correlated factors affecting the increase of the MJS space.

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